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Title: Warhead verification concepts and technologies

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Warhead verification concepts and technologies

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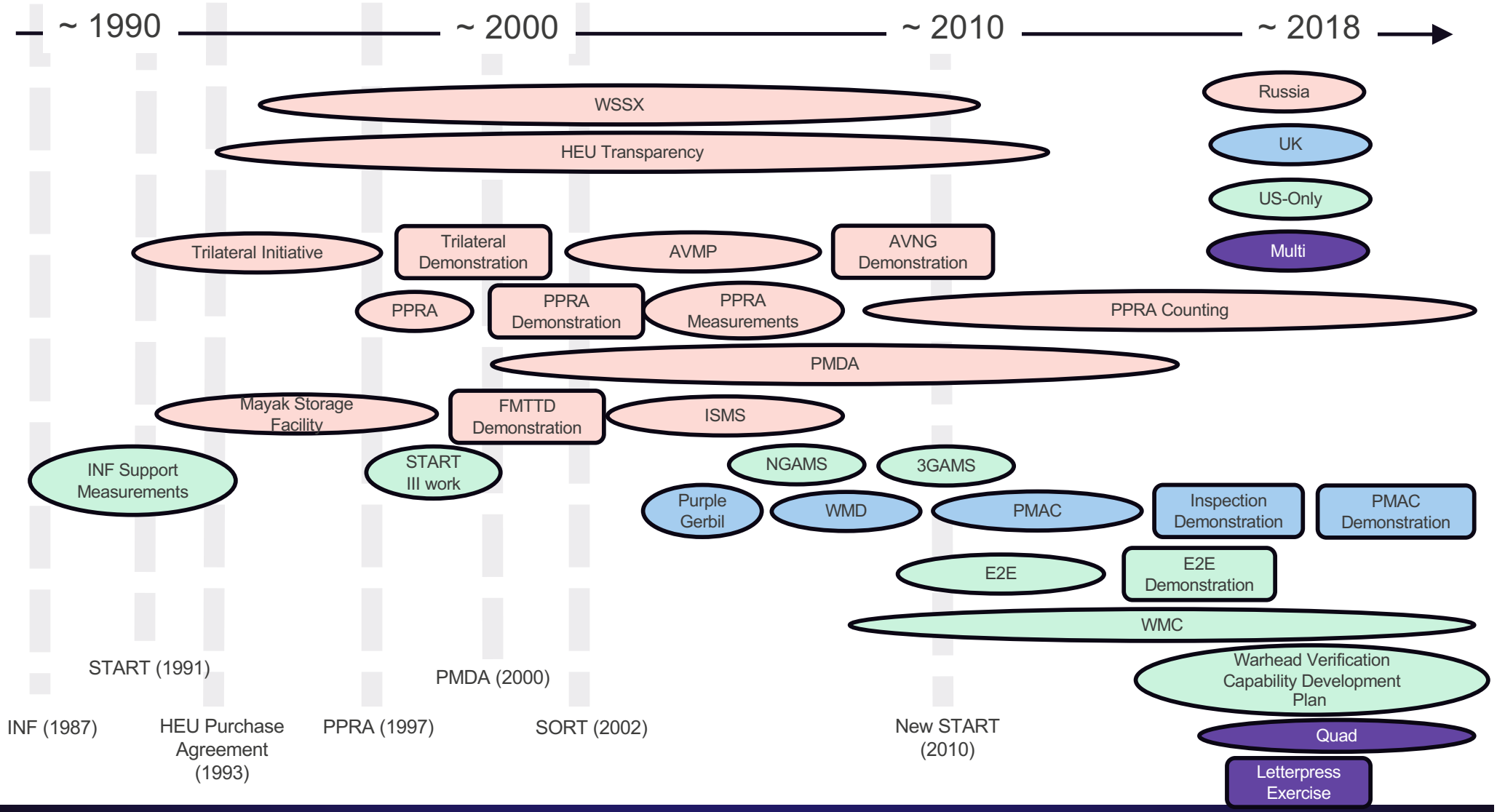
NNSA
National Nuclear Security Administration
Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA

Many years, many efforts



What are the technical questions?

How many nuclear weapons do you have?

- Can we count nuclear weapons?
- Can we determine if something isn't a weapon?
- Can we determine if something is a weapon?

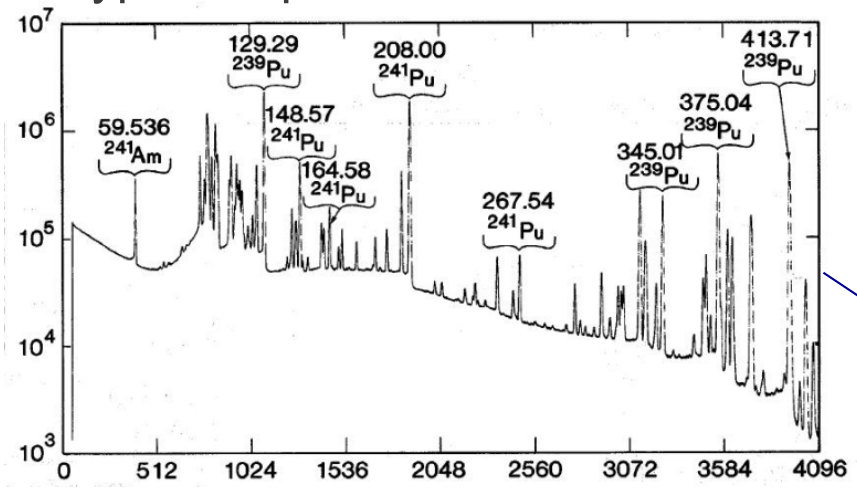
Is this a nuclear weapon?

Arms control instrumentation: A three part problem

- Measurement – What is that thing?
  - Start with an “easy” case – clean plutonium
- Certification – Are the equipment and processes permissible at this location?
  - Safety?
  - Information protection?
  - The host’s problem?
- Authentication – Can the results be trusted?
  - Spoofing?
  - Accurate?
  - The inspector’s problem?

Measurements - Attributes

Type of Special Nuclear Material



Analysis and threshold comparison

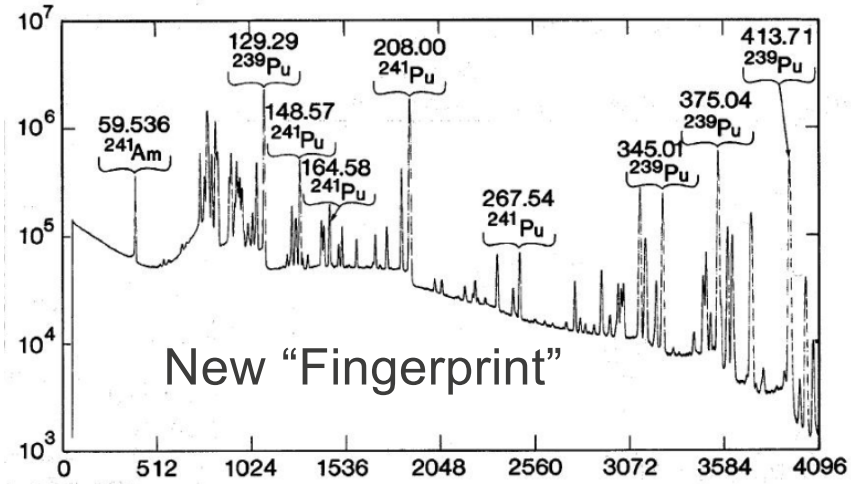
Pass | Fail

Mass of Special Nuclear Material

- Singles Rate: $S = F\varepsilon M \nu s_1(1+\alpha)$
- Doubles Rate: $D = F(fD/2)(\varepsilon M)^2 \{\nu s_2 + [(M-1)/(\nu i_1-1)] \nu s_1(1+\alpha) \nu i_2\}$
- Triples Rate: $T = F(fT/6)(\varepsilon M)^3 \{\nu s_3 + [(M-1)/(\nu i_1-1)][3\nu s_2 \nu i_2 + \nu s_1(1+\alpha) \nu i_3] + 3[(M-1)/(\nu i_1-1)]^2 \nu s_1(1+\alpha) \nu i_2\}$

Use agreed unclassified properties

Measurements - Templates



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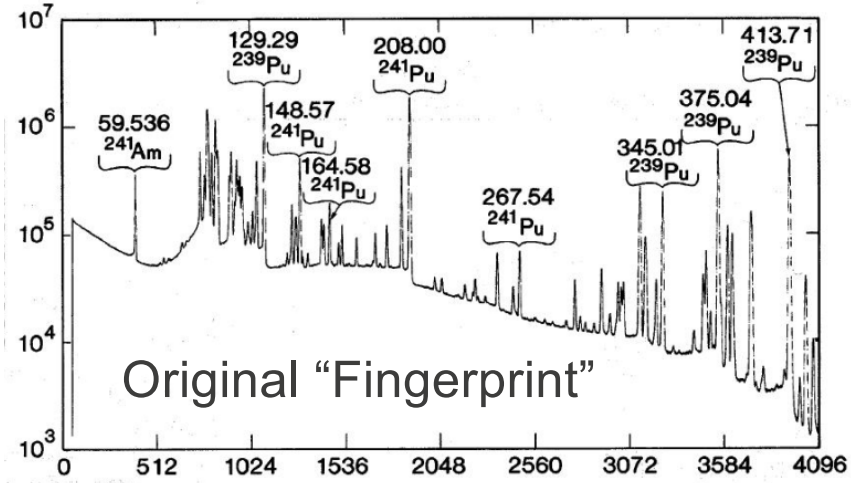


Pass Fail

Does it match a trusted item?

Certification (Host)

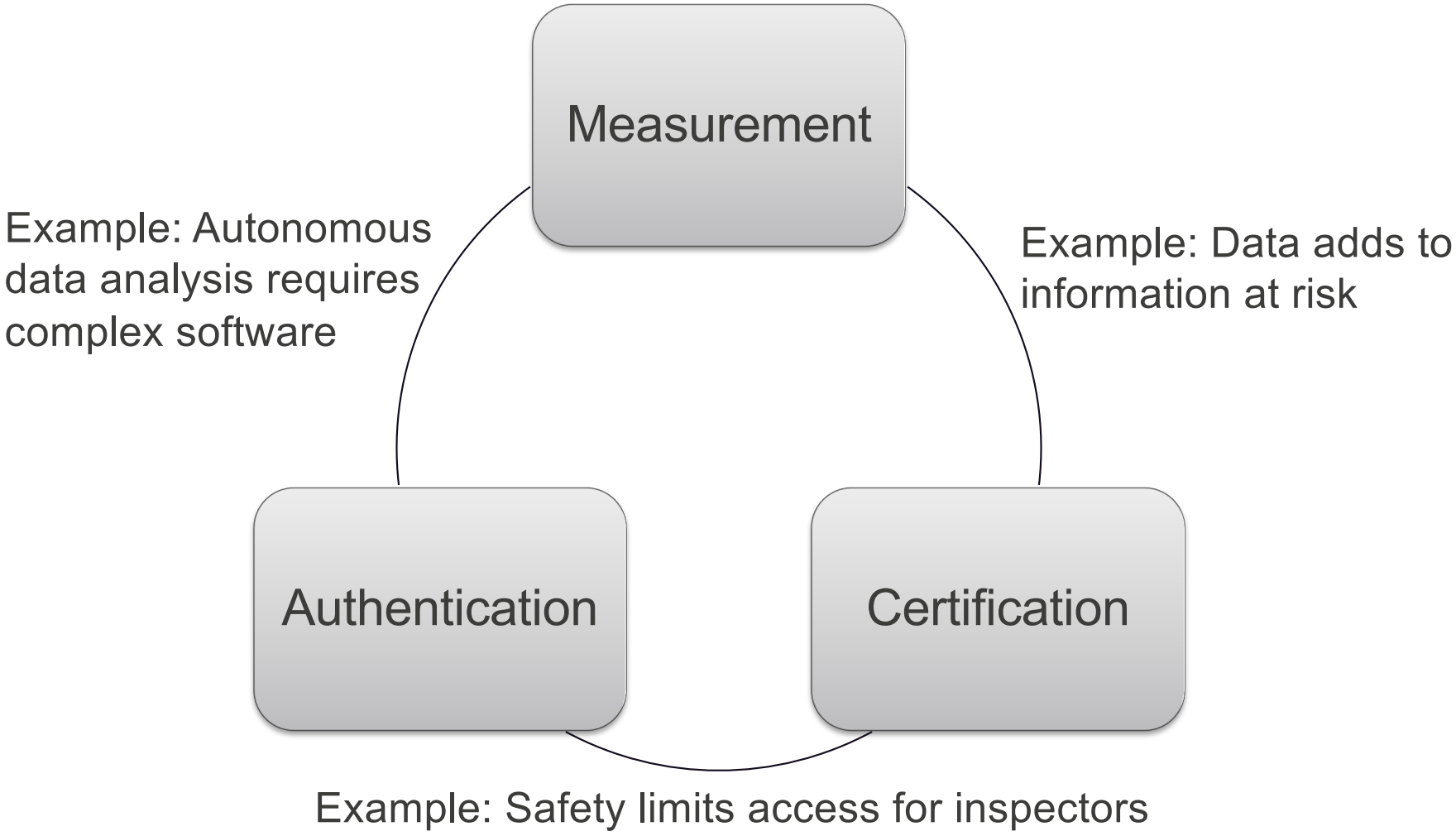
Process used to ensure the safety and security of inspection equipment, especially equipment operated near nuclear, explosive, or other hazardous or sensitive materials.

Certification includes confirming that sensitive host information is not revealed through inspector data.

Authentication (Inspector)

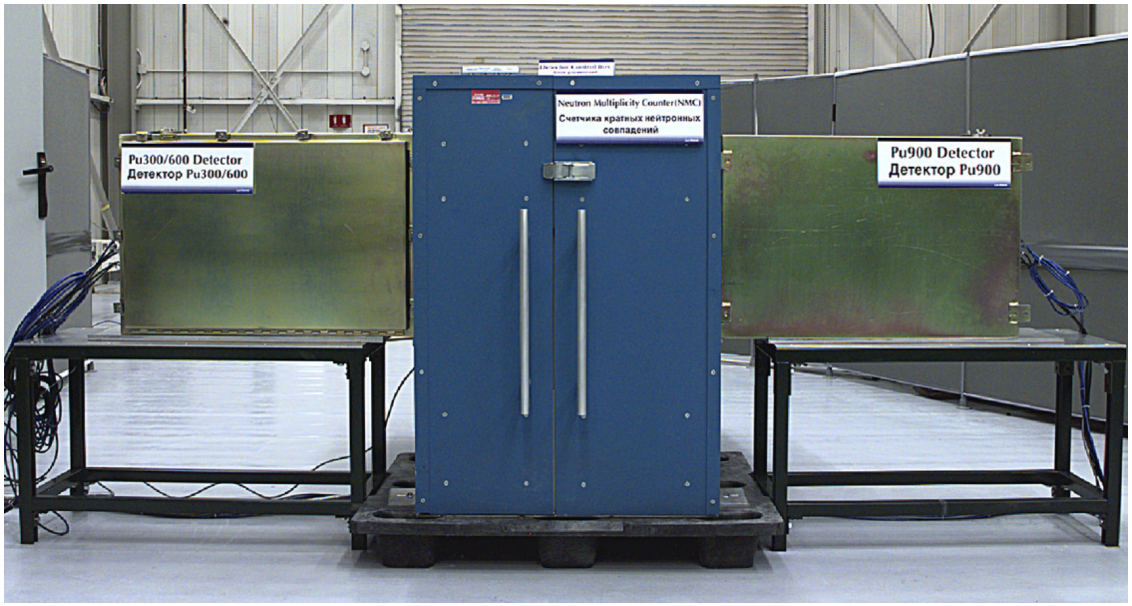
Process used to ensure that inspection equipment is performing as designed and that generated data can be trusted.

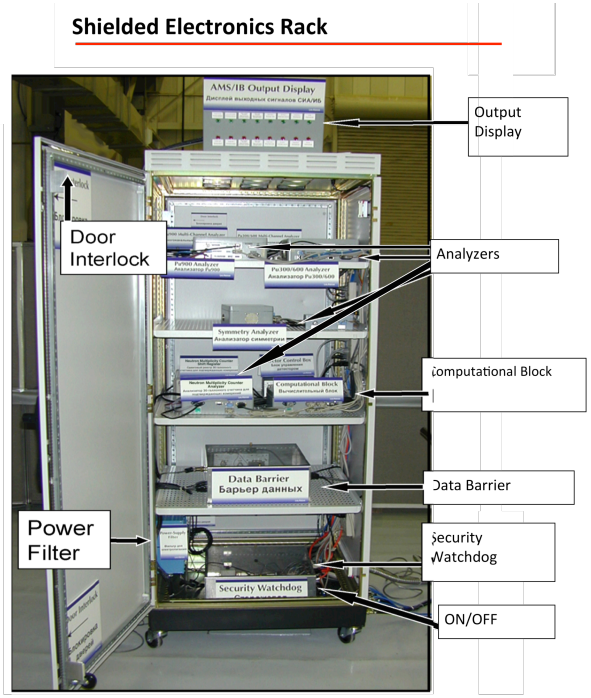
Tradeoffs


Measurement
Example: Autonomous data analysis requires complex software
Example: Data adds to information at risk
Authentication
Certification
Example: Safety limits access for inspectors

Fissile Material Transparency Technology Demonstration - LANL hosted Russian delegation - 2001

Only measurement of its kind ever performed.





- ✓ Measurement
- ✓ Certification
- ✗ Authentication

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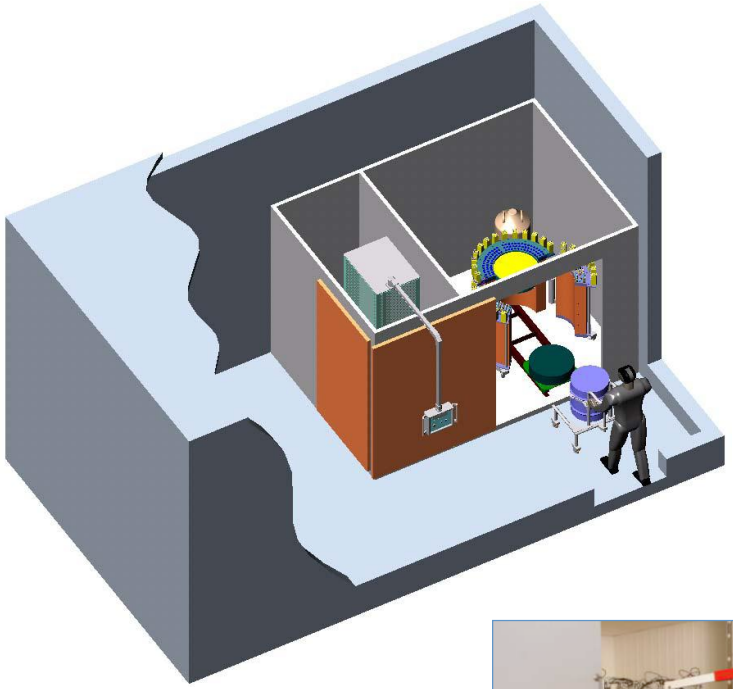
AVNG – A Russian-Built, RF-US Developed, Attribute Measurement System – Sarov hosted US - 2009



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- ✓ Measurement
- ✗ Certification
- ✓ Authentication

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Questions?